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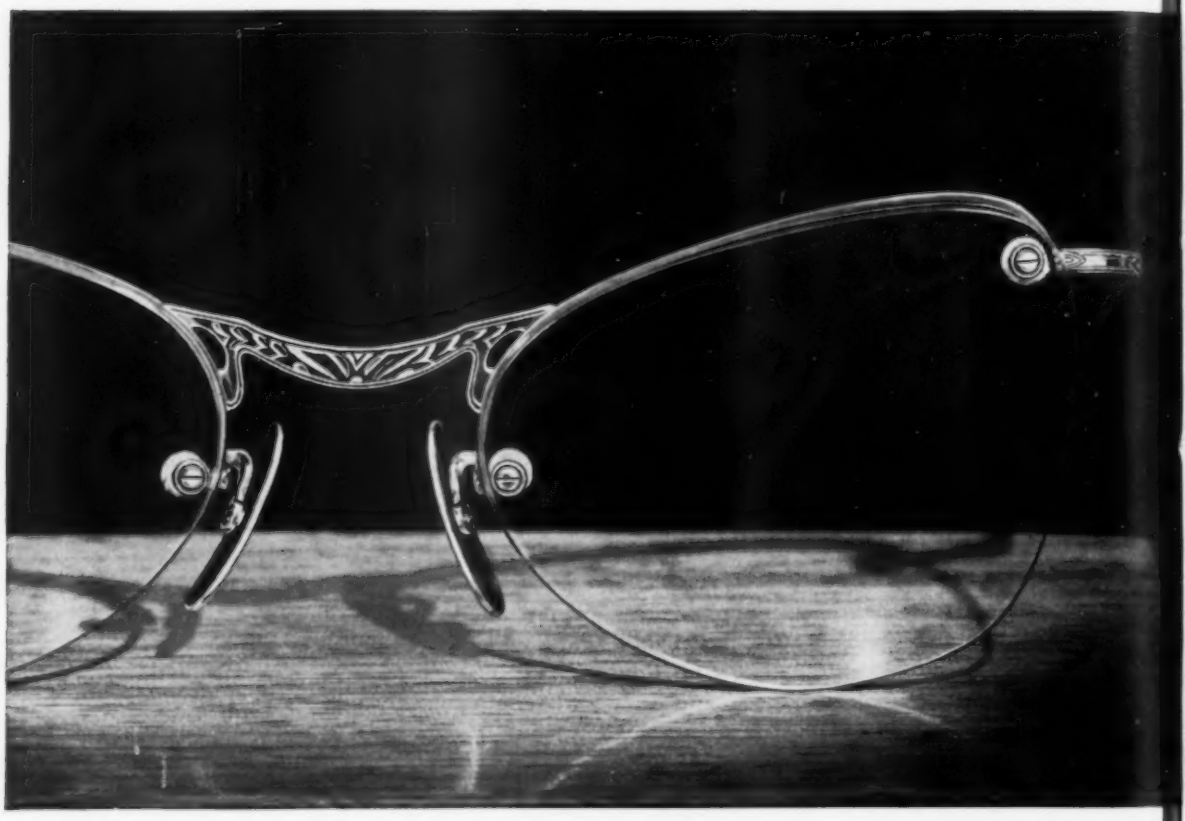

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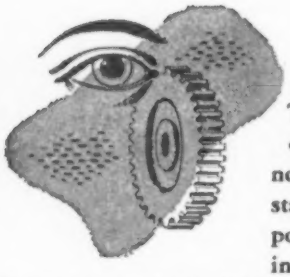
BAUSCH & LOMB INDUSTR

What it



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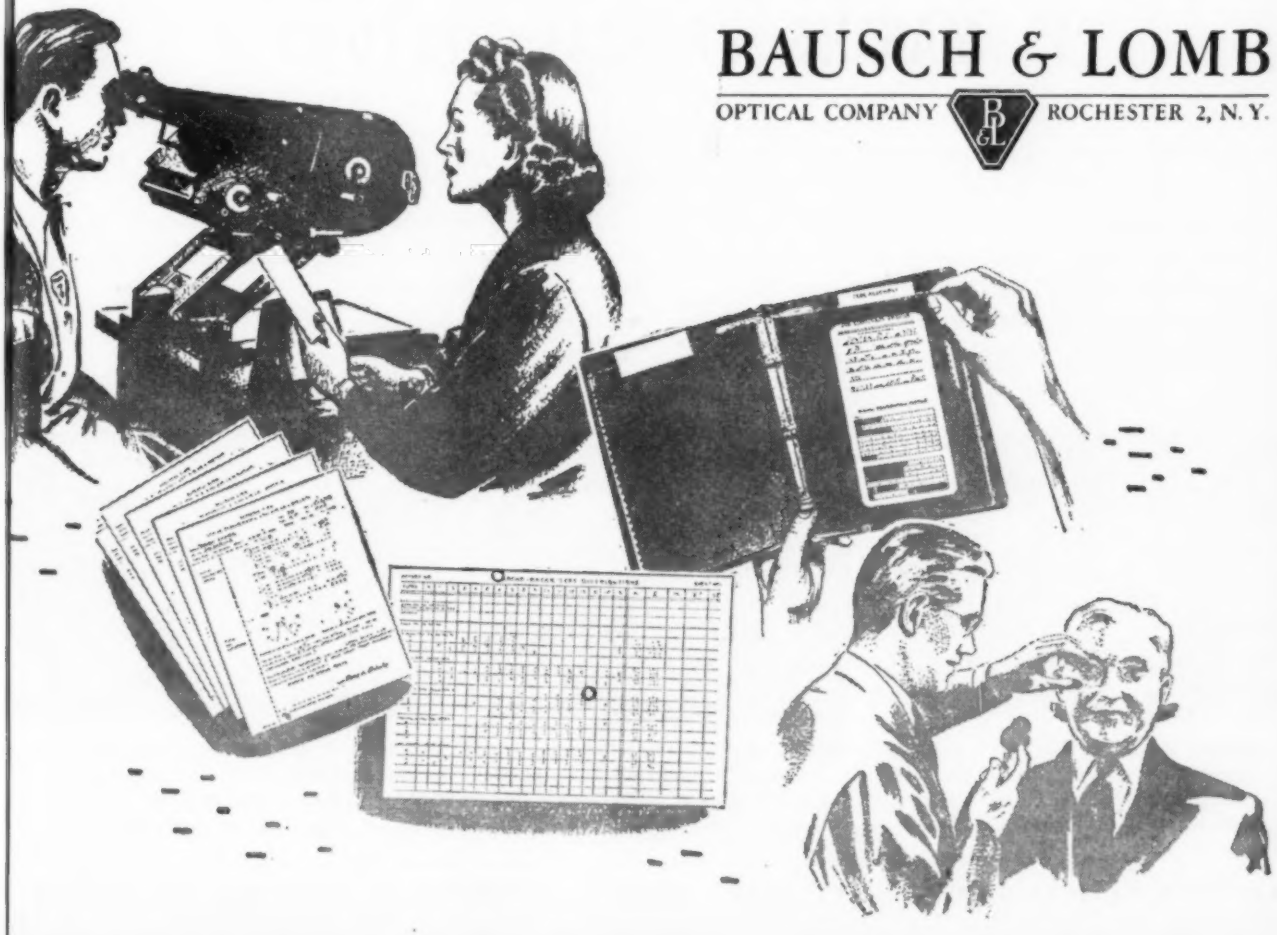

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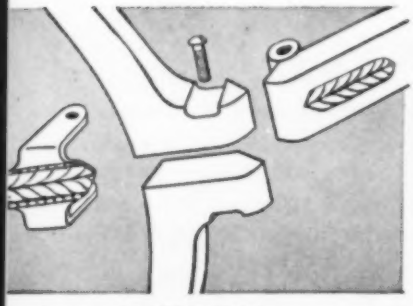

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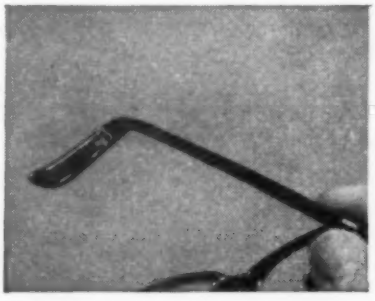

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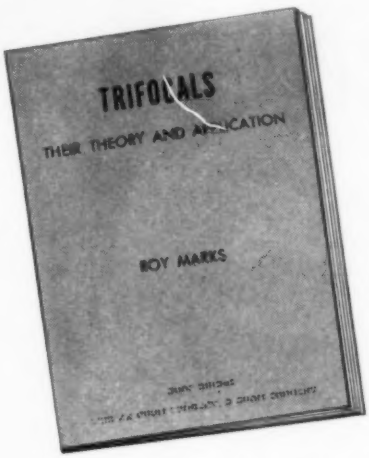

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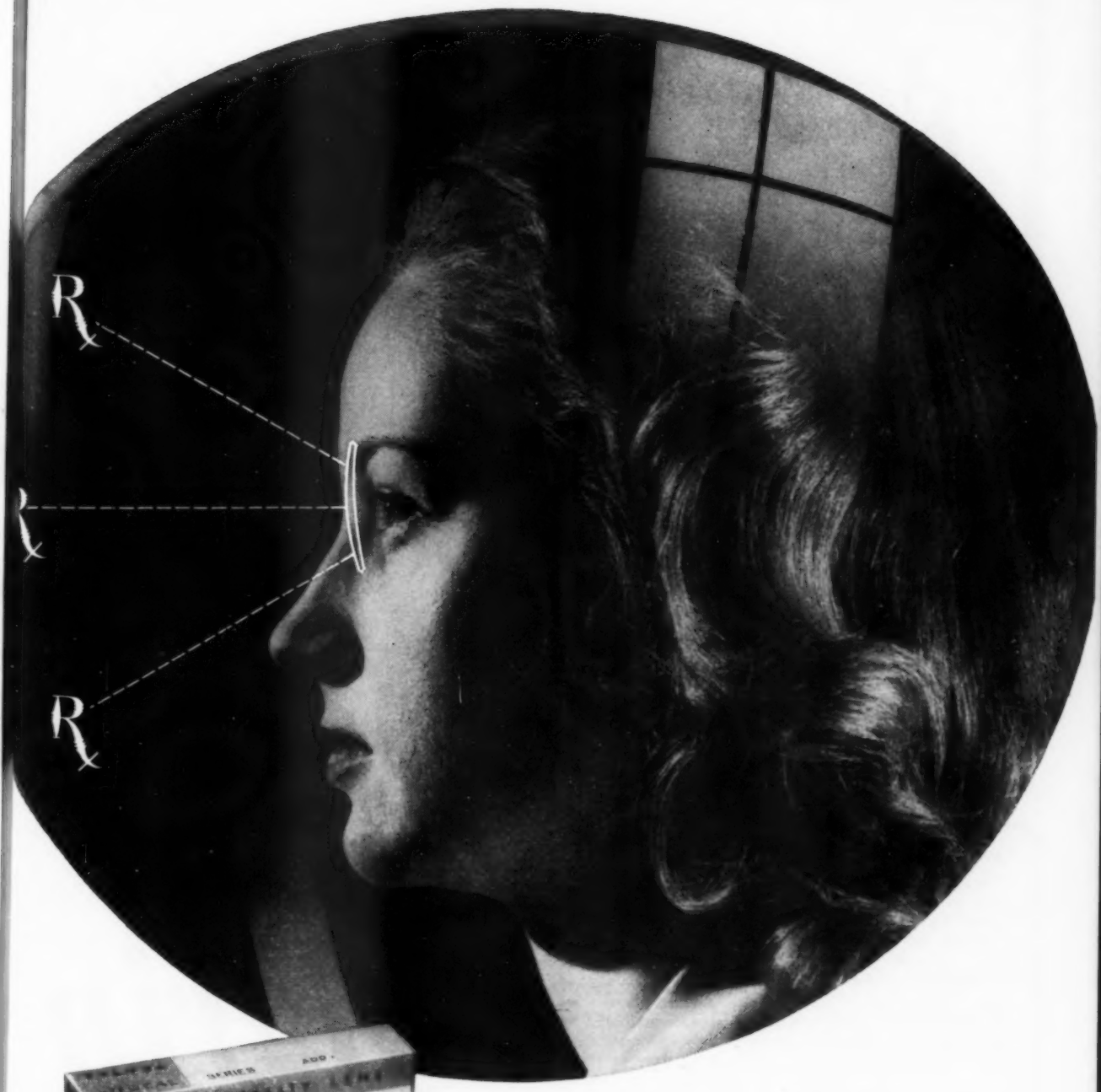

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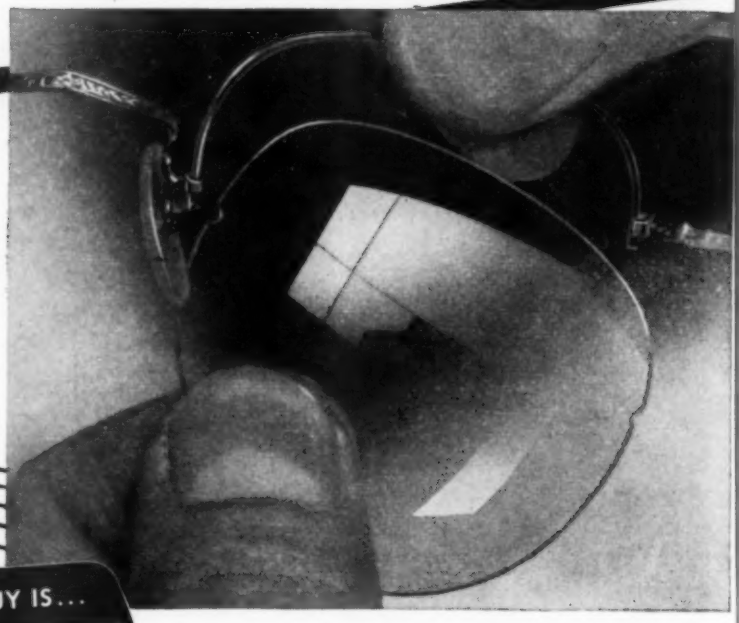

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Vol. 25 FEBRUARY, 1948 No. 2

METHODS USED IN THE TREATMENT OF SQUINT*

Merdith W. Morgan, Jr.†
School of Optometry, University of California
Berkeley, California

This paper is not a report of any new phase or new development in the orthoptic treatment of strabismus. It is an attempt to present in a systematic manner our present knowledge of the subject, presenting methods which we have found most useful in the clinic of the School of Optometry of the University of California. Obviously not all phases of the subject can be reported in such a paper as this one. Therefore, practical usefulness will be the guiding principle in the choice of material to be presented.

Strabismus is the ocular condition which is characterized by the use of one eye for fixation while the other eye is directed to some other point in the field of vision. We shall confine our attention to the type of strabismus which has been termed concomitant. This is the type in which the deviation remains constant in all directions of gaze providing accommodation remains constant. Also the angle of deviation remains the same regardless of which eye fixates, the normally fixating eye or the normally deviating eye.

The deviation is the most apparent factor in concomitant squint and it is also used as one of the criteria of classification, and yet at the present state of our knowledge it is probably safe to call the deviation a symptom or a bi-product of the loss of normal binocular vision rather than the cause for the loss of normal binocular vision. As yet, we do not know with any certainty the reasons for the various phe-

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*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 16, 1947. For publication in the February, 1948, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow, American Academy of Optometry. Assistant Professor of Optometry.

nomena associated with strabismus. The deviation itself, except in the obvious accommodative squints, is probably supra-nuclear in origin. The very term concomitant implies that, as far as we can detect, the neuromuscular mechanism is functioning normally. Hofstetter has shown that the relation between accommodation and convergence is perfectly normal. Under general anesthesia, which places a "block" between the higher cortical levels and the lower more automatic centers of the brain, the squint disappears (Adler). It seems that the only conclusion that one can draw from these facts is that the cause of the deviation is truly associated with some malfunctioning of higher brain areas. Fortunately it is not necessary to know the true cause of strabismus to be successful in its treatment by orthoptic methods.

The type of strabismus is denoted first by the direction and the amplitude of the deviation. The familiar terms esotropia, exotropia, hypertropia, and cyclotropia are used to describe the direction of the deviation. The amplitude is generally designated in arc degrees, prism diopters, or centrads.

Strabismus is also classified by its continuity in time. Some squints occur only occasionally while at all other times the eyes behave in what appears casually to be a perfectly normal fashion. Such squints are generally termed intermittent or periodic. On the other hand, most squints are apparent at all times. These are called constant.

Strabismus is further classified by whether one eye constantly deviates or whether it is first one eye and then the other which turns. If the squint is such that one eye only deviates, it is called unilateral squint while if it is one eye and then the other which deviates it is called alternating strabismus. The alternating type is further subdivided depending on the type of alternation. If first one eye and then the other is used for fixation at will, then the squint is said to be of the essential alternating type. In contrast to this, is the condition in which either eye may be used under certain conditions for fixation but ordinarily only one is used. This type of squint is the accidental alternating type.

As we have already intimated, heterotropia has characteristics other than the actual deviation of the eyes which set it apart from normal binocular vision. In addition, there are some factors which we would expect to be different but which are not. Before undertaking the orthoptic training of squint we must arrive at some understanding of these characteristics of heterotropia.

In the first place, even though the eyes are not fixating the same

object when concomitant strabismus exists, there is generally no diplopia either physiologic or pathologic. Ordinarily we find that there are suppression areas, particularly in the deviating eye. These suppression areas do not as a rule occupy the whole field of vision but only those portions of the visual field which might give rise to diplopia. Thus there are areas of binocular vision of a sort. These suppression areas are apparent only when binocular vision is attempted. If the normally fixating eye is covered, the areas of neutralization in the squinting eye entirely disappear. These areas can only be demonstrated when binocular vision is attempted. They can actually be plotted as scotoma using the Pigeon-Cantonnet stereoscope or the stereocampimeter.

Related to the suppression, but differing in at least one important essential is the amblyopia which is frequently found in squint. The important difference is that the amblyopia is present even when the fixating eye is covered. According to Chavasse the degree of the amblyopia depends on the age of onset of the squint. Visual acuity develops with age according to this idea. At the time of the onset of the squint, normal progressive development ceases and the visual acuity either stays more or less constant or regresses from this point. If it regresses it can rapidly be restored by occlusion methods to its former state of development. Further progress beyond this point will be found to occur only very slowly if at all. Chavasse gives the following values for the normal development of visual acuity:

AGE	*VISUAL ACUITY*
4 months	20/2000
6 months	20/1000
9 months	20/240
1 year	20/166
2 years	20/40
3 years	20/30
4 years	20/25
5 years	20/20 or better

These figures are not to be interpreted literally but only roughly. For example the visual acuity at one year could normally vary from 20/100 to 20/200 or even more.

The use of this chart can be illustrated by an example. Suppose that a patient with strabismus has amblyopia such that the visual acuity is 20/200 in one eye. Now let us further suppose that there is good evidence that the squint developed at age two. We can then expect that we can successfully improve the visual acuity to approximately 20/40.

Burian has shown in a few subjects which he has investigated that the light sense in strabismic subjects with amblyopia is perfectly normal in every respect. Suppression, as we have already seen, disappears when the fixing eye is occluded. These results seem to indicate that neither suppression nor amblyopia is due to malfunctioning of the lower visual pathways. The lesion, if it may be called such, apparently must be cortical.

In dealing with suppression and amblyopia, particularly the latter, great care must be exercised in ruling out actual central scotomas. As suppression disappears when one eye is covered, the possibility of confusing suppression and scotomata is fairly remote. It is extremely easy to confuse amblyopia and central scotoma. The subject in central scotoma uses an area adjacent to the fovea which naturally has reduced visual acuity. The most satisfactory method of detecting central scotomas is that developed by Brock.

There is also the possibility of amblyopia being due to anomalous fixation. When this fixation area used in place of the fovea is near the fovea, it is extremely difficult to detect. As a matter of fact, while such a condition is a possible explanation of some of observed phenomena, the writer is not sure whether it exists or not. That is, a normal fovea which is not used for fixation.

Hofstetter has demonstrated that momentary changes in the angle of the squint are possible especially in exotropia. These momentary changes, and those due to hysteria and to accommodative changes, may make it difficult to label a squint as concomitant without considerable study. However, in the average squinter this decision is easily made.

Probably the least understood characteristic of some cases of strabismus is anomalous correspondence. In this condition there is a point or area in the squinting eye which becomes associated with the foveal area of the fixating eye. This area has frequently been called a "false macula." The main objection to this term is that this area has none of the characteristics of the normal macula except that it tends to be associated with the macula of the fixing eye. The area is not entirely constant in location. Fusion movements of a sort sometimes appear to be elicited when the macula of the fixing eye and the anomalous central area in the deviating eye are stimulated simultaneously. Not infrequently, phoria and duction measurements may apparently be made. These subjects frequently pass correctly nearly all of the Keystone DB series tests. Consequently, a false measurement of the angle of the squint will result if the anomalous correspondence

has not been detected. Frequently the correspondence is such that subjectively fusion occurs near what would appear to be orthophoria.

Thus in anomalous correspondence with esotropia some area in the nasal retina of the deviating eye has the same spatial projection as the macula of the fixating eye. There may be said to be three types of anomalous correspondence. The first is harmonious anomalous correspondence. In this condition the area under the image in the squinting eye has a straight ahead projection when the non-deviating eye fixes an object straight ahead. It is this type of anomalous correspondence which apparently has binocular vision of a sort and is frequently missed in routine refractions where the angle is small. According to Adler, five per cent of the subjects with anomalous correspondence fall into this category. The second type of anomalous correspondence is called unharmonious. In this type, the macula of the fixating eye is associated with an area between the macula and the point where the image customarily falls in the deviating eye. In this condition the subjective angle of the squint is less than the objective angle but a squint is measurable both subjectively and objectively, although there is a possibility of confusing the condition with a large phoria. According to Adler, 15 per cent of the subjects with anomalous correspondence fall in this category. The third type of anomalous correspondence is the type in which there really is no correspondence. Here the suppression area is so large in the deviating eye that no particular area can be said to be associated with macula area in the fixating eye. According to Adler 80 per cent of the subjects with anomalous correspondence belong in this category.

The method of measuring squint subjectively which is outlined later on in this paper does not support the percentage distribution given by Adler. The data from the orthoptic clinic of the School of Optometry of the University of California indicates that about 15 per cent of the subjects have harmonious anomalous correspondence, 50 per cent unharmonious, and the balance suppression anomalous correspondence.

The cause of anomalous correspondence has not been determined. It has been claimed that anomalous correspondence develops only when the squint is of long standing. This has not been our experience. Adler has pointed out that anomalous correspondence is related to the angle of the squint. It rarely appears when the angle of the squint is less than 15°.

The difference between the true angle of the squint and the ap-

parent subjective angle is termed the angle of the anomaly, or the angle of anomalous correspondence. Thus in harmonious anomalous correspondence the angle of anomaly is equal to that of the tropia, in unharmonious anomalous correspondence the angle of the anomaly is less than the angle of the squint, and in suppression anomalous correspondence the angle of the anomaly varies from moment to moment through the range of zero to some angle greater than that of the squint. The range of variation depends on the size of the area of neutralization.

Brock prefers to use the term anomalous correct projection in place of anomalous correspondence. There is a great deal of merit to this idea. Correspondence seems to be innate and always correct. No one has ever reported a case in which the two halves of the visual field of one eye do not exactly meet. If anomalous correspondence were innate, one would suppose that such a condition should occasionally be found. Even in cases where we say anomalous correspondence exists the cure is frequently instantaneous when the patient grasps the idea of correct projection and all evidence of suppression is eliminated. The condition which is found when these sudden changes occur is that of normal correspondence and not another different anomalous condition. Squinters with anomalous correspondence seem to project in the squinting eye as though they were using a muscle sense rather than retinal local signs.

From the standpoint of definition there is an objection against the use of the term corresponding. Corresponding points are defined both as points having identical local sign so that the projection outward into space gives the same visual direction and as points whose simultanous stimulation lead to a unitary perception. Obviously, the latter definition would almost always rule out the use of the term corresponding when speaking of squinters. However, if one uses the first definition in thinking of the term corresponding, then the use of the descriptive phrase anomalous correspondence is not subject to such serious objections.

While it is extremely difficult to obtain an adequate term to describe the condition known as anomalous correspondence, the demonstration that the foveal or macular regions of the two eyes are not corresponding points provides a practical method of diagnosing anomalous correspondence in the majority of patients. The definition of Swan is probably the least objectionable, "An anomaly of binocular vision in which areas in the two retinas normally having a common

visual direction acquire an unstable and often variable visual direction in relation to each other but usually in accordance with the squinting position."

In some cases of strabismus, the fovea of the deviating eye is not used for fixation when the normally fixating eye is covered. This is termed anomalous fixation. Usually this is due to a central scotoma in the deviating eye.

Strabismic patients exhibit various degrees of simultaneous vision. Occasionally fusion and even stereopsis may be demonstrated when both fovea are stimulated simultaneously. More frequently fusion cannot be elicited and when the targets are of a fusionable nature one of them is suppressed. However, when the targets are obviously non-fusable simultaneous vision can be shown to exist in the majority of cases. In a few cases both foveal areas apparently cannot be stimulated at the same time. This condition is termed horror fusionalis.

Even though the deviation is a symptom rather than a cause, it is the deviation that allows us to measure progress and also to detect anomalous correspondence. Therefore, it is essential that some accurate method of measuring the angle of the squint be utilized.

The simplest method of measuring the angle of squint is that originated by Hirschberg. In this method, a small light is held about 50 cms. from the eyes. The subject fixates the light while the clinician observes the reflected image of the light on the cornea of the deviating eye. If we assume that the pupil is 3½ mm. in diameter, then if the reflection appears at the margin of the pupil the squint is between 12° and 15° (20△ to 27△). If the image is halfway between the pupil margin and the limbus, the angle of the squint is about 25° (46△). If the reflex is at the limbus, the deviation is approximately 45° (100△).

The angle of the squint can also be measured accurately using the perimeter. If the measurement is to be accurate, the angle kappa which is the angle between the visual line and the center of the pupil must be measured. Frequently reference is made to the angle gamma which is the angle between the visual line and the optical axis. Unfortunately this angle cannot be measured readily.

In order to measure the angle kappa, the normally fixating eye is occluded. The deviating eye is centered behind the cheek rest of the perimeter and the subject requested to observe the fixation target on the perimeter. A small light is placed just under the target and the observer places his eye directly over the target. If now the reflection

appears to the nasal side of the center of the pupil, the angle kappa is positive. If to the temporal side, the angle is negative. The observer now moves his eye along the arc of the perimeter until the reflex appears to be central. The number of degrees that the observer had to move his eye is twice the angle kappa.

A positive angle kappa makes convergent squint appear less than it actually is while a negative angle makes convergent squint appear more than it actually is. The reverse is true in exotropia.

In order to measure the squint, the normally fixating eye is uncovered and fixation of the central spot on the arc of the perimeter is maintained by this eye. Then both the light and the observer's eye are moved around the arc of the perimeter together until once more the reflex appears central. Originally the patient was supposed to fixate a distant object but with a modern-day perimeter this is not possible. Therefore, the measurement obtained is one in which approximately 3.0 D of accommodation is in use—the angle measured in convergent squint will thus be about 12△ too great and in exotropia the same amount too small. If esotropia exists and the angle kappa was positive the two values are added and the result is the angle of the squint. If the angle kappa was negative, however, this value is subtracted from the apparent angle of esotropia to give the true angle. The reverse procedure is used in exotropia.

The angle of deviation may also be measured by the screen or cover test. The normally fixated eye is directed toward a distant object. This eye is then covered and the movement of the deviating eye is watched. If esotropia exists, prisms of gradually increasing strength are held before the eyes, until no movement of the deviating eye can be detected when the fixating eye is covered and the patient is forced to fixate with the deviating eye. The movement of the normally fixating eye may also be observed when the cover is removed from the eye. If the same prism results in no movement of either eye, we have evidence of concomitancy.

The major amblyoscopes such as the synoptophore, troposcope, rotoscope, or synoptoscope may be used to objectively measure the angle of the squint. The method of centering the corneal reflexes or the method of neutralizing the movement when fixating changes from one eye to the other may be used.

A subjective measurement of the angle of the squint as well as an objective one must be made. The easiest method is by using the same technique generally used to measure phorias. As a rule, the ob-

jection to this method is the inability of the patient to appreciate diplopia. This may generally be done if a red filter is placed over one eye and sufficient vertical prism introduced to satisfy the patient's subconscious mind that there really are two different objects in space. Additional devices such as making one object appear to be flashing by using a cover intermittently may be necessary before diplopia can be elicited.

If one of the major amblyoscopes is available, this is the most satisfactory method of making a subjective measurement of the squint. Two targets such as a square and a much smaller ball are used. The subject is directed to move the ball until it appears centered within the square. If the suppression area is too big, the patient is asked to move the ball from one side of the square toward the square and to report when the ball or the square disappears. The ball is then moved to the other side and an attempt is made to put the ball in the square from this side. Again a notation is made of the angle at which suppression occurs. The mid-point between these measurements offers a first approximation of the angle of the squint.

It has already been pointed out that when the angle of the strabismus is 15° or more, abnormal correspondence makes up a large percentage of the cases. It is interesting to note that the blind spot of the eye occupies an area in the nasal retina of some 5.5° horizontally. This extends approximately from 13° to 18.5° from the macula. Thus when there is an esotropia of about 15° there is a natural made, ever-present "suppression area" under the image in the deviating eye corresponding to the image upon the macula of the fixing eye.

The objective and subjective angles, using similar methods and the same accommodative effort, are compared. If these two measurements are in reasonable agreement, normal correspondence exists. However, if these two types of measurement differ radically, anomalous correspondence exists. Not infrequently it will be found that anomalous correspondence exists when the subject uses his normally fixating eye for fixation but when he is forced to use his normally deviating eye for fixation, normal correspondence exists. If anomalous correspondence is found to exist by comparing the subjective and objective measurements, the after image test for correspondence should be made.

The squinter observes first a vertical light filament for 5 to 15 seconds with his deviating eye. This eye is then covered and he looks at the filament in a horizontal position for approximately the same

length of time. The light is turned off and the subject asked to stare off into space and reports what he sees. If the negative after images do not appear shortly, the room lights are turned on and an attempt made to see the negative after images of the light streaks. Frequently flashing the room lights off and on or having the patient open and shut his eye rapidly will make the after images visible. When the patient sees these images, he is asked to represent either by drawing or using his fingers the relative position of the images to each other. If he reports that the after images form a cross, normal correspondence by this method of measurement is the diagnosis. On the other hand, if the lights do not form a cross the diagnosis is one of anomalous correspondence. If the after images cannot be discerned, the test should be repeated but the lights presented in the reverse order; that is, to the fixating eye first and to the deviating eye next.

Frequently anomalous correspondence is shown by the comparison of the subjective and objective measurements of the tropia while normal correspondence is shown by the after image test. Burian interprets this to mean that the anomalous condition is not deep seated. On the other hand, if both types of measurements show anomalous correspondence the condition is deep seated and will be difficult to remove.

In the investigation of squint, the following information should be obtained from the history:

1. *Present age:* It has been our experience that in order to benefit from orthoptic training the patient must be intelligent enough to follow directions. It is difficult to state at what age a patient becomes intelligent enough to cooperate, but about 7 years of age is probably the proper age. The upper age limit is equally difficult to state but it is somewhere around 30. Best results are obtained with college age students.

2. *Age of onset of squint:* This is usually difficult to establish. Old family photos are frequently helpful. This information is helpful in predicting the probable results, especially for the elimination of amblyopia.

3. *Mode of onset:* This is helpful in any attempt to establish a cause for the squint.

4. *Heredity:* This is also helpful in establishing a cause. Every attempt should be made to sort out squints of a paretic or mechanical origin.

The examination of the patient should include the following:

1. Visual acuity with and without correction.
2. Refractive error.
3. Fixation ability in either eye.
4. Motility, noting particularly if there is any restriction of movement of the deviating eye.
5. Type of squint.
   a. direction.
   b. unilateral.
   c. alternating.
      (1) essential.
      (2) accidental.
6. Degree of squint.
   a. objective measurement.
   b. subjective measurement.
   c. influence of the prescription on the angle of the squint.
7. After image test, if objective and subjective angle differ.
8. Concomitancy of squint.
9. Suppression.
   a. area.
   b. degree.
10. Type of binocular vision.
    a. complete unilateral vision.
    b. simultaneous vision.
    c. fusion.
    d. stereopsis.
11. Cooperativeness of patient.

The last point is perhaps the most important of all. Before orthoptics can be successful the patient must be strongly motivated and sincere in his desire. He also must have the necessary intelligence to follow instruction.

Before undertaking treatment it is important to be able to make an intelligent prognosis. The simplest way to make this judgment is on the basis of past failures. Various authorities have reported their causes of failure in training. These are listed below in order of their importance as the cause of failure.

Feldman

1. Failure to overcome suppression.
2. Failure to improve amblyopia sufficiently.
3. Failure to overcome anomalous correspondence.
4. A variable vertical unbalance.

Hitz

1. Anomalous correspondence.
2. Marked anisometropia.
3. Aniseikonia.
4. Variable vertical unbalance.

Allen

1. Anomalous correspondence.
2. Amblyopia.
3. Vertical unbalance.

Lancaster

1. Suppression.
2. Anomalous correspondence.
3. Failure to build amplitude of fusion movements.
4. Failure to convert laboratory skills into daily need.
5. Failure to arouse active rather than passive response on the part of the patient.

Costenbader

1. Amblyopia.
2. Suppression.
3. Anomalous correspondence.
4. Varying vertical unbalance.
5. Failure to distinguish between the accommodative and mechanical elements.
6. Failure to stabilize.

If these causes are weighted and the total taken it is found that the usual causes of failure in order of their importance are:

1. Failure to establish normal correspondence when anomalous correspondence exists.
2. Failure to overcome suppression.
3. Failure to overcome amblyopia.
4. Vertical unbalance, particularly if variable.

The first three seem to be related in some way. As Giles has pointed out, "It has been found that abnormal correspondence appears to coincide with the existence of a suppression area. . . . With the disappearance of this suppression area, simultaneous vision is restored, and in most cases there exists no abnormal retinal correspondence."

On the basis of these sources of failure, it is possible to make an intelligent prognosis. If any patient has all four difficulties: anomalous correspondence, suppression, amblyopia and varying vertical un-

balance, treatment is bound to be prolonged and success doubtful. All other factors such as cooperation on the part of the patient, patient intelligence, age of onset, etc., should be favorable. On the other hand, if none of the four most common causes of failure are present, the orthoptic cure of the squint should be obtained.

The treatment of strabismus is easy in theory and difficult in application. This can readily be divided into several different programs depending on the results of the initial investigation. If the correspondence is normal, if the vision in the poorer eye is 20/60 or better, and if there is no binocular vision, our present program proceeds as follows:

1. Establishment of lustre through the lid of the squinting eye.
2. Establishment of lustre and proper spatial projection using a major amblyoscope.
3. Establishment of superimposition.
4. Establishment of peripheral fusion at least 5° out from point of fixation.
5. Establishment of color fusion for the whole field.
6. Reduction of peripheral fusion targets in size.
7. Establishment of macular fusion.
8. Use of stereoscopic targets.
9. Attempt to build amplitude.

If the correspondence is not normal and if the vision in the poorer eye is 20/60 or better, the first task is to attempt to eliminate the anomalous correspondence.

1. Establishment of lustre through the lid of the squinting eye.
2. Removal of the suppression area using the Pigeon Cantonnet stereoscope. The technic is to place smaller and smaller objects over the fixated spot.
3. Alternate and simultaneous flashing of color at the angle of squint.
4. The use of gross, non-fusion targets at the angle of squint, moving target before squinting eye.
   a. Move the target before the deviating eye back and forth near the angle of squint.
   b. The arms of the synoptophore are set at an angle other than that for the anomalous angle or the angle of squint and the patient looks back and forth from one target to the other.

5. Alternate patching of the eyes—the patient to have monocular vision except while receiving treatment.
6. Version movements with the targets set at the objective angle of the squint.
7. Lustre at the angle of the squint.
8. Peripheral fusion targets at the angle of the squint.
9. No macular fusion targets until normal correspondence is established.

In all technics as soon as lustre and correct projection have been obtained, the patient is trained to use effort in overcoming his squint. This idea owes its origin to Catonnet and its full development to Giles. The patient tries to move his eyes through mental effort. The Remy Separator is used. This is nothing more nor less than a septum approximately 25 to 40 cms. long with a target board at right angles to it. The target consists of two different colored papers. The patient holds the septum against his nose and looks at the colored targets. He will report generally that he sees both targets separated by a fairly large space. In the case of esotropia, he is asked to imagine that the targets are receding. If the patient succeeds in making a divergent movement, the two colored squares will move toward each other. After a time he will get the "feel" of this movement, and can perform it at will without the Remy Separator. In case of exotropia the patient is instructed to imagine that the target is approaching.

If there is amblyopia in addition to the squint, the amblyopia must receive attention first. The treatment of amblyopia followed is:

1. Monocular occlusion.
2. Partial occlusion.
   a. painting the lens with lacquer.
   b. partial polish of the lens.
3. Flashing of colors at the angle of squint.
4. Flashing of forms at the angle of squint.
5. Use of special books such as Evans, "Monocular Visual Training," Williams and Wilkins.
6. Attempt to get the patient to put forth effort.

Before undertaking orthoptic training there are a certain number of instruments which are necessary.

1. One of the major amblyoscopes.
2. Stereoscopes.
   a. mirror type such as Pigeon Cantonnet or cheiroscope.

b. Brewster type.

3. Red and green filter spectacles, construction paper, scissors, paste and imagination.

The lustre technics owe their origin largely to the work of Brock. The easiest method of establishing lustre is through the closed lid. The patient fixates a black spot on gray or neutral background. The squinting eye is closed and a small pocket flashlight is held against the lid and the light flashed on and off. The patient is directed to try to transfer the glow seen to the gray background. Since the glowing source, as far as the eye is concerned, is the lid which is inside the primary focal point of the eye, the retina of the deviating eye becomes illuminated by a light without obvious direction. It is, therefore, more easy to convince the patient to project glow correctly.

When the patient projects correctly through the closed lid, the same technic is used employing one of the major amblyoscopes in which the glow comes from the same visual direction as that of the fixating eye. This light is flashed off and on until the patient superimposes it upon the fixated spot.

In order to obtain superimposition it is easier to start with targets which are obviously dissimilar and which might occupy the same space at the same time—a bird and cage are the classical targets.

As both Burian and Brock have pointed out, peripheral fusion is much easier to obtain than central fusion. The targets can be peripheral circles and squares of at least 5° angular size. As peripheral fusion is obtained, central color fusion can be tried. Also the peripheral targets can be reduced in size 4°, 3°, 2° and finally 1°.

The materials readily available which we have found most useful are Brock's B U series, published by the Keystone View Company. These slides are available both in the opaque form and as transparencies. The slides for the synoptophore available in this country through the American Optical Company are extremely useful. The A series slides are used for testing and the F, G, H, and D series for training.

Peripheral fusion cards must be made. This is readily accomplished by using black construction paper, glass lantern slides, colored cellophane, scissors, binding tape, and imagination. Brock rings of various sizes can be easily made from construction paper.

In closing I would like to state that while several treatment routines have been mentioned in this paper, the surest way to fail in the orthoptic treatment of squint is to treat patients with heterotropia by routine methods. Success is dependent on obtaining the patient's

cooperation and in trying to visualize yourself just what his problem is and modifying the treatment to suit the patient.

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PARTIAL PTOSIS OF THE LEFT LID CORRECTED WITH PTOSIS CRUTCH—A CASE REPORT*

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HISTORY

Patient, female, age 18. Occupation, stenographer. The patient has a partial ptosis of the left upper lid. Her eyes itch and burn. She suffers from frontal headaches after doing close work, these becoming worse in the late afternoons with continued use of the eyes. She also has headaches after watching motion pictures. Her eyes seem sensitive to light, both artificial and daylight. She has used a very low-powered sphero-cylinder for the past two years while at work and at school.

The patient reports that her health is excellent, her only prior diseases as a child being whooping cough and measles. She has had a complete physical and dental examination made within the past six months and reports that both were negative in their findings. She reports no family history of ocular problems.

In addition to being sensitive about the ptosis of the left lid, she presents the following complaint: "My head aches in the front part of my head when typing, bookkeeping or taking dictation: also when reading, eyes burn and itch, and the movies bring about headaches. which are usually dull. Headaches have been present since breaking my glasses, and lights bother me."

PRELIMINARY FINDINGS

Uncorrected visual acuity: O.D. 20/20 O.S. 20/25 O.U. 20/20.

Patient is of good physical structure with symmetrical features. The globes of the eyes are not protruded. There is a marked partial ptosis of the left eye reported to have been present since birth. Figure One. Patient is quite sensitive about this condition and upon questioning stated that at one time she thought of having a surgical operation for the correction of this problem. Versions and rotations are smooth and adequate, except for the obstruction in the upper field of the left

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Figure One. Lid without ptosis crutch.

eye, due to the ptosis of the lid. Amplitude of triangulation, diplopia at three inches. Fixations are adequate with the exception of the obstruction of the left eye lid. Pupillary reaction to light is good, also with response to accommodation. The lids are of good color, smooth and no eruptions present. The eyelashes are well placed. No tumors of the lachrymal apparatus, or any type of inflammation or discharge. The sclera is of good color. No inflammation, discoloration or swelling.

EXTERNAL AND OPHTHALMOSCOPIC EXAMINATION

The cornea is clear with no inflammation present, or ulcers. The iris does not have any adhesions or swelling. There are no opacities or haziness of the aqueous, vitreous or the lens. No hemorrhages are present in any of the media. The optic disc is of good color, and well defined at the edges with the choroidal ring present in all sectors. The cupping of the disc is medium in depth. The vessels are in ratio. The fundus is clear, has good color, and free of exudates, hemorrhages, and negative as to pathology.

ANALYTICAL EXAMINATION

Ophthalmometer: O. D. 42.00 × 180 degree —42.25 × 90 degree
O. S. 42.00 × 180 degree —42.25 × 90 degree

Habitual phoria at distance: Orthophoria.

Habitual phoria at near: 4 prism diopters.

Static retinoscopy: O. D. +0.25 D. sph. ⌒ —0.25 D. cyl. ax. 90
O. S. +0.50 D. sph. ⌒ —0.25 D. cyl. ax. 90

Dynamic retinoscopy: O. D. +0.75 D. sph. ⌒ —0.25 D. cyl. ax. 90
fixation at 20 inches. O. S. +1.00 D. sph. ⌒ —0.25 D. cyl. ax. 90

Dynamic retinoscopy: O. D. +0.50 D. sph. ⌒ —0.25 D. cyl. ax. 90
fixation at 40 inches. O. S. +0.75 D. sph ⌒ —0.25 D. cyl. ax. 90

Subjective: O. D. +0.37 D. sph. ⌒ —0.25 D. cyl. ax. 90
O. S. +0.62 D. sph. ⌒ —0.25 D. cyl. ax. 90

Visual acuity with subjective: O. D. 20/20 O. S. 20/20 O. U. 20/20.

Induced phoria with subjective: Orthophoria.

Adduction to first blur: 4 prism diopters.

Adduction break: 22 prism diopters - recovery 6 prism diopters.

Abduction break: 14 prism diopters - recovery zero.

Vertical phoria: Negative.

Induced phoria with subjective at 16 inches: 5 prism diopters.

Cross cylinder, fused: O. D. +0.75 D. sph. ⌒ —0.25 D. cyl. ax. 90
O. S. +1.00 D. sph. ⌒ —0.25 D. cyl. ax. 90

Induced cross cylinder phoria: 5 prism diopters exophoria.

Adductive stimulation: 21 prism diopters.

Positive fusional reserve: 21 prism diopters break and 2 prism diopters recovery

Abductive inhibition: 20 prism diopters.

Negative fusional reserve: 20 break and 8 prism diopters recovery.

Vertical phoria at 16 inches: Negative.

Amplitude accommodation: 3.50 diopters.

Stimulation to accommodation: Minus 3.75 diopters.

Inhibition to accommodation: Plus 1.00 diopters.

Bichrome test with subjective: Equal for red and green.

DIAGNOSIS

This is a case of accommodative fatigue, inasmuch as the dynamic retinoscopic findings, as compared to the static retinoscopic findings are high, with consideration given to the low amplitude of accom-

modation. The adduction to first blur is lower than the expected, which should be 7 to 9 prism diopters. The abduction break finding has a lower recovery than the adduction finding at the distance. Positive reserve recovery is lower than the negative reserve finding at the near point. Included with the information above is a partial ptosis of the left eye. This is congenital with no indications of pathology. The formula given was based upon the inhibition to accommodation, with consideration given to the equilibrium findings, amplitudes and lags of accommodation, with additional information obtained with the bichrome test, and the application of a ptosis crutch for the left eye (see Figure Two), with a No. 1 shade absorption lens, and a formula to balance acuity.

The formula prescribed is as follows:

O. D. +0.25 D. cyl. ax. 180

O. S. +0.25 D. sph. ⊃ +0.25 D. cyl. ax. 180

Figure Two. Lid with ptosis crutch in place.

PROGNOSIS

The refractive condition will be taken care of by the formula to eliminate the visual symptoms, and the ptosis crutch to improve the

cosmetic appearance of the patient. This will bring about the successful conclusion of the case after the readaptation has taken place behind the formula.

COMMENT

The patient did not present herself to me for a ptosis crutch or with any knowledge that anything could be of help to her in reference to this type of service. However, upon suggestion as to the possibilities, she agreed to have this type of work rendered. She was the most cooperative and appreciative individual that I have ever had the pleasure of working with in any similar type case.

SUMMARY

The patient originally was seeking professional service to eliminate visual symptoms, with no conception of receiving any assistance relative to ptosis. The refractive correction solved the visual symptoms, and the ptosis crutch improved the cosmetic appearance of the patient to such an extent as to alter her social behavior. The successful conclusion of this case can only be expressed by a personal interview with the patient, in which she cites a complete change of mode in living habits.

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THE EFFECT OF PRISM ON ESOTROPIA—A CASE REPORT*

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INTRODUCTION

One of the adjuncts to the correction of strabismus occasionally employed in clinical practice is the prescription of a relieving prism to compensate for all or part of the angle of squint. The prism so prescribed is intended to place the images of a fixated object on or near corresponding points of the two retinas.

Most of the authors of squint techniques recognize that the use of relieving prisms seems more or less logical, but their references to this procedure are typically casual.

Cantonnet and Filliozat[1], for example, merely point out that "in very difficult cases, e.g., the case of subjects incapable of a mental effort, prisms are indispensable." Maddox[2] describes the procedure and recommends its use in cases of both concomitant and noncomitant strabismus. He states that results will usually be more satisfactory in nonparalytic cases. Lyle and Jackson[3] also describe the technique for fitting prisms on squinters, but point out that "owing to the inconvenience of heavy prisms for constant use and the dispersion of light which they cause their use has not been generally advocated." Emsley[4] recommends the use of relieving prisms for subjects who are experiencing difficulty in obtaining binocular vision when away from the training instrument. Giles[5] employs prism corrections in both lateral and vertical strabismus of small amounts (up to 5°). Recently Brombach[6] has used relieving prisms in the treatment of several strabismus subjects.

In contrast with the implications of the above mentioned are the results obtained by Hofstetter[7] in a study of the effect of prisms on the angle of squint. He reports that when relieving prisms were pre-

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scribed for constant wear in two esotropic subjects, the angles of squint were considerably increased.

This paper is a report of a preliminary study of the effect of the prescription of a relieving prism on the angle of squint of one of the authors (M.A.), who has a convergent esotropia.

PRELIMINARY ANALYSIS OF THE SQUINT

The subject has a concomitant esotropia both with and without the lenses worn to correct for the refractive errors. The onset is believed to have occurred at the age of three following an attack of measles. When the strabismus was first observed, the subject was prescribed glasses to correct for the refractive error. These lenses are reported to have reduced the angle of squint sufficiently to eliminate it as a cosmetic handicap; no further treatment was attempted at that time. During the few years immediately prior to the present study, several more-or-less indifferent attempts had been made by the subject to establish normal, single, binocular vision, but without success.

The squint is predominantly of the left eye, but can be alternated at will. The rotations and versions are normal, with the angle of squint remaining essentially the same in all directions of fixation. The pupils react normally to both light and accommodation. Diplopia fields were not charted as the subject is unable to obtain diplopia under the ordinary conditions of the test. The angle of squint is considerably decreased when the subject puts on his glasses. A routine examination of the external parts of the eye revealed no other abnormalities.

Ophthalmoscopic examination revealed some small opacities in the vitreous body of the left eye. The media otherwise are clear; the fundi appear normal.

The following findings were obtained in the routine refractive examination:

V. A. (No Rx.)	O. D.	20/800	
	O. S.	20/800	
Retinoscope:	O. D.	+5.25 —1.50 x 172½°	
	O. S.	+5.00 —1.25 x 180°	
Subjective Refraction:	O. D.	+5.25 —1.50 x 172½°	
	O. S.	+5.00 —1.25 x 180°	
Rx.	O. D.	+5.50 —1.00 x 167°	V. A. 20/20
	O. S.	+4.75 —1.00 x 165°	V. A. 20/20

The subjective angle of squint measured by means of a Maddox rod and a spot of light varied between 2△ eso and 2△ exo.

Measurements of the angle of squint were made on the troposcope.[8]

The subjective angle of squint through the subject's prescription varied from 2△ exotropia to 2△ esotropia. The test targets used in this measurement consisted of a brightly illuminated, broken vertical line seen by one eye and a broken horizontal line seen by the other eye. A bright circular spot at the center of each line provides a fusion stimulus when the lines are seen as a perfect cross. The measurement consists of adjusting the angular separation of the targets until a cross is seen. Actually the perfect cross was never obtained by the subject; instead, one of the targets, typically the one seen by the left eye, would disappear just as the targets approached the position at which they would be expected to superimpose. The extent of this suppression field so measured was approximately 4△ horizontally and 4△ vertically. The mid-point of the suppression field was assumed to represent the point of subjective superimposition.

The objective angle of squint through the subject's correction averaged 13½△. To make this measurement, the subject was instructed to fixate the bright spot in the center of each target while they were being alternately flashed so that only one target at a time was visible. The angular separation of the targets was simultaneously adjusted until no motion of the subject's eyes occurred upon alternation of fixation. The angle indicated on the troposcope scale was recorded as the objective angle of squint.

This measurement was checked by another method of determination of the objective angle of squint. While the subject fixated one of the targets, the angular separation of the targets was adjusted until the corneal reflex of the non-fixating eye was observed to be ½ mm. nasal to the center of the pupil (to compensate for the angle lambda[9]). The angle indicated on the troposcope scale was then recorded as the objective angle of squint. The two methods of determination of the objective angle of squint gave identical results, the average error in several repeated measurements being approximately ½△ for each method.

The ratio of accommodative convergence to accommodation (the ACA ratio) was determined by measuring the objective angle of the squint for various amounts of stimulus to accommodation. The target for the stimulus to accommodation was provided by a transil-

luminated slide of a reduced Snellen chart. The amount of this stimulus was determined by the amount of minus sphere inserted in the lens cells of the troposcope. It was assumed that the subject actually accommodated for the stimulus when the smallest letters were seen clearly.

The ACA ratio was found to be approximately 6△ to 1 D., as may be seen from the slope of the lines in Figure 1. The ACA value 6/1 means that the angle of squint was approximately the same for all distances of fixation. It may well be reasoned that the resultant constancy of the angle of squint would be highly favorable to the development of anomalous correspondence.

It is obvious from the difference in values of the subjective and objective angle of squint that the subject has anomalous correspondence. This was further verified by the after-image test made in the manner described by Bielschowsky.[10] In this test, the subject first fixated with his right eye the center of a long vertical filament lamp for 15 or 20 seconds while his left eye was occluded. He then fixated with his left eye (the right eye being occluded) the same lamp placed horizontally for 15 or 20 seconds. Following these exposures, he observed both the positive and negative after-images of the lamp filaments with an attempt to see the horizontal and vertical lines simultaneously, as a cross. Instead, he saw a vertical after-image to the left of the horizontal after-image, indicating the presence of anomalous correspondence, and the failure to use normal correspondence.

A series of orthoptic exercises was then employed in an attempt to re-establish normal retinal correspondence. The training was carried on over a period of six weeks with sessions approximately three times a week, each session being 45 minutes to an hour. The procedure for re-establishing normal correspondence consisted mainly of a variety of attempts to elicit a monocular diplopia of the type dependent upon simultaneous use of both the anomalous and normal retinal correspondence systems. Several techniques were used:

1. *After images.* The after-image technique for the detection of anomalous correspondence was employed repeatedly and for long periods of time in the attempt to elicit monocular diplopia. The subject was seated in a totally dark room and instructed to fixate the filament of the electric light for several seconds with each eye. When the light was turned off, the subject attempted to obtain a monocular diplopia of either or both of the after-image. The same pro-

cedure was repeated under a variety of illumination and fixation conditions.

2. *The Troposcope.* The subject fixated a set of dissimilar targets on the troposcope with the arms set at the objective angle of the squint. For example, while the subject fixated a small bright spot with one eye, a large bright circle was maintained on the line of sight (and therefore on the fovea) of the other eye. Variations in the choice of eye fixating the dot, in the relative luminances (brightnesses) of the two targets, colors, flashing, etc., were also employed. Through all this the subject attempted to project either or both of the targets in two directions simultaneously, or, more specifically, to see a circle surrounding the spot in addition to the circle seen to one side or the other.

During the series of training sessions, no monocular diplopia had been elicited and no variation in the angle of squint was observed. In comparison to the previous experience of one of the authors (H.W.H.)

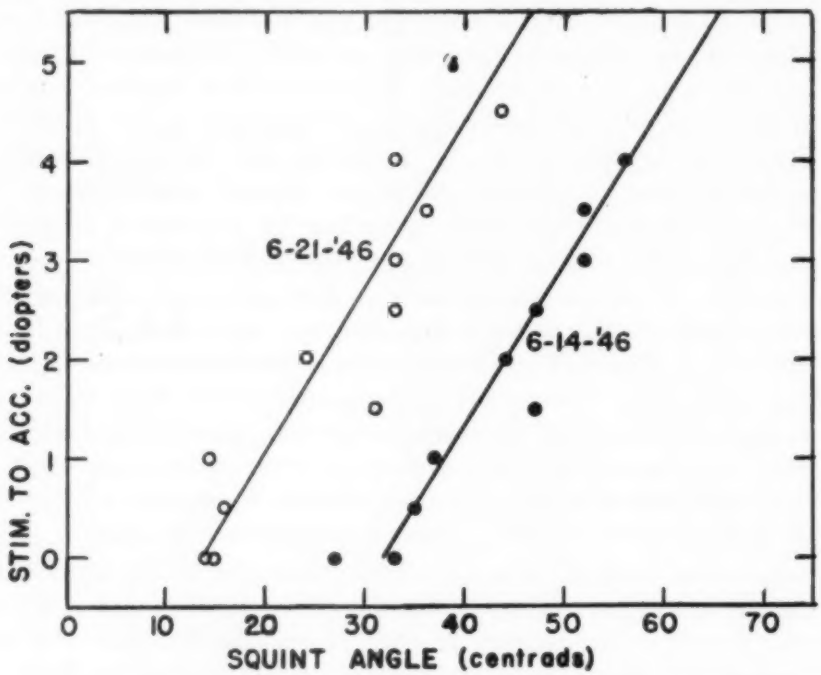

Figure 1. The angle of squint for various amounts of stimulus to accommodation. The dots represent measurements made during one of the periods that the prism Rx. was being worn. The circles represent measurements made some time after the prism Rx. was removed and the angle of squint had returned to its original value.

in the training of squinters, and in eliciting of monocular diplopia in squinters with anomalous correspondence, it was decided that the anomalous correspondence in the subject was well established.

EFFECT OF PRISMS

The subject was then fitted with a prescription which contained 18△ base-out. The total prescription was as follows:

O. D. +5.25 —1.75 × 172 9△ B. O.
O. S. +5.00 —1.50 × 182 9△ B. O.

These lenses were worn continuously from 8:00 A.M. June 10, 1946, until 2:24 P.M. June 14, 1946, except during sleeping hours. Measurements of the objective angle of squint were made periodically (on an average of twice a day) beginning at 11:00 A.M., June 10, throughout this period. These measurements indicated that within three hours after the prisms were first worn the angle of the squint had increased from approximately 14△ to 32△ and deviated very little from the maximum value during the remainder of the five-day period (See Table I).

The nature of the change is illustrated in Figure 1. The dots in the figure represent the angle of squint at various stimulus levels of accommodation as measured through the prism correction and the circles

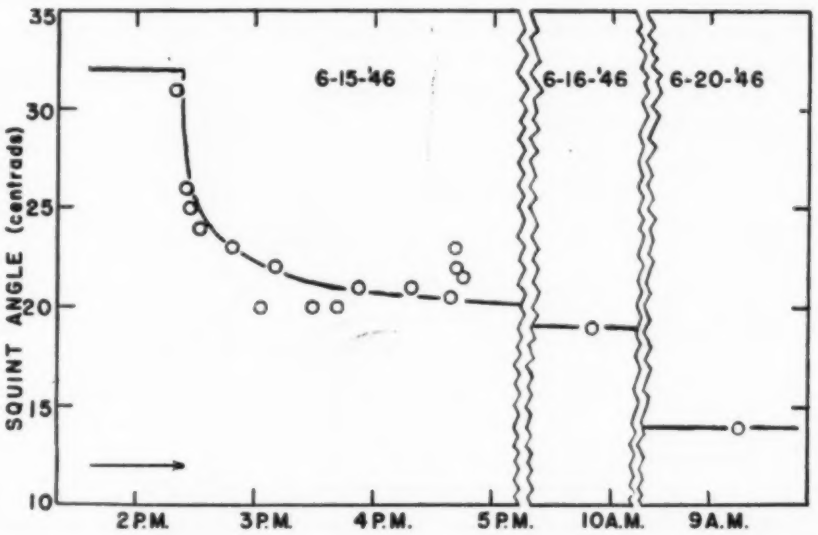

Figure 2. The changes in angle of squint following the removal of the prism Rx. which had been worn for several days. The point of the arrow indicates the time at which the prism Rx. was removed.

represent the angle of squint at various stimulus levels to accommodation as measured through the regular correction. The solid line through each set of data represents an ACA ratio of 6△ to 1 D. It is seen that the prism Rx. increased the angle of the squint approximately 18△ at all stimulus levels of accommodation but did not change the ACA ratio.

At 2:25 P.M. on June 14, the prism correction was replaced with the regular correction and the objective angle of the squint was measured at frequent intervals during the next hour and at occasional intervals subsequently. The results are plotted in Figure 2. In this figure, the abscissa represents time in hours and the ordinate represents the angle of squint in centrads. It is seen that with the removal of the prisms the angle of squint falls at a very rapid rate for the first few minutes and then gradually levels off. The original angle of squint was not regained until some time between June 16 and June 20.

On June 22, an attempt was made to observe the manner in which the angle of squint increased when the prisms were put on. In addition the measurements of the decreasing angle were repeated when the prisms were removed. The results of this experiment are plotted in Figure 3.

The data show that the increase in squint angle was more rapid than the decrease. The data in Figure 3 also indicate that the adapta-

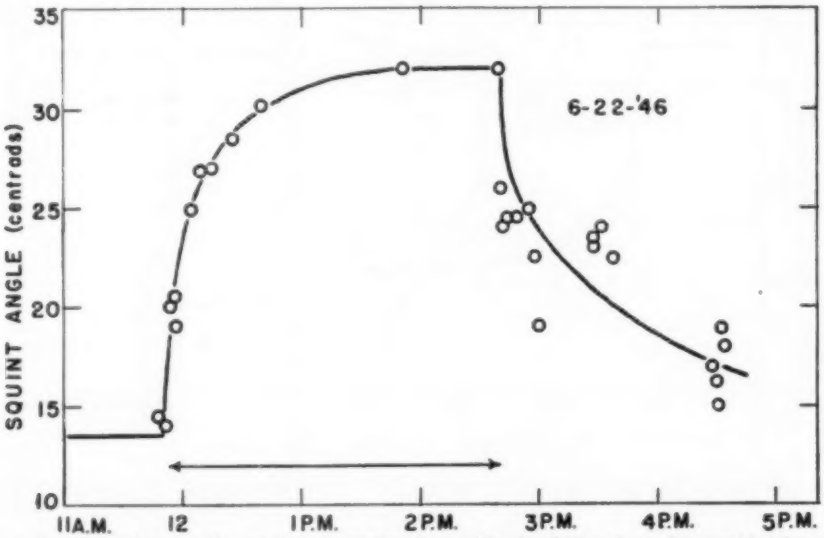

Figure 3. The changes in angle of squint immediately following the application and subsequent removal of the prism Rx. The interval between the arrow tips represents the total time the prisms were worn.

TABLE I

Date	*Time*	*Rx.*	*Measurement Through Rx. (Centrads)*	*Squint Angle (Centrads)*
6-10-46	7:55 A.M.	Reg.	14	14
	8:00 A.M.	Started wearing prism Rx.		
	11:00 A.M.	Prism	16	34
6-11-46	3:00 P.M.	Prism	16	34
6-12-46	10:45 A.M.	Prism	15	33
	10:46 A.M.	Started wearing regular Rx.		
	10:48 A.M.	Reg.	25	25
	10:50 A.M.	Started wearing prism Rx.		
	11:00 A.M.	Prism	11	29
6-13-46	11:00 A.M.	Prism	12.5	30.5
6-14-46	1:00 P.M.	Prism	Measured ACA ratio.	
	2:20 P.M.	Prism	13	31
	2:24 P.M.	Started wearing regular Rx.		
	2:25 P.M.	Reg.	26	26
	2:27 P.M.	Reg.	25	25
	2:28 P.M.	Reg.	24	24
	2:32 P.M.	Reg.	24	24
	2:48 P.M.	Reg.	23	23
	3:03 P.M.	Reg.	20	20
	3:10 P.M.	Reg.	22	22
	3:20 P.M.	Reg.	22	22
	3:29 P.M.	Reg.	20	20
	3:41 P.M.	Reg.	20	20
	3:52 P.M.	Reg.	21	21
	4:19 P.M.	Reg.	21	21
	4:39 P.M.	Reg.	20.5	20.5
	4:41 P.M.	Reg.	23	23
	4:42 P.M.	Reg.	22	22
	4:43 P.M.	Reg.	20.5	20.5
	4:45 P.M.	Reg.	21.5	21.5
6-15-46	9:50 A.M.	Reg.	19	19
6-20-46	9:15 A.M.	Reg.	14	14
	9:20 A.M.	Reg.	14	14
6-21-46	2:20 P.M.	Reg.	Measured ACA ratio.	
6-22-46	11:48 A.M.	Reg.	14.5	14.5
	11:52 A.M.	Reg.	14	14
	11:53 A.M.	Started wearing prism Rx.		
	11:54 A.M.	Prism	2	20
	11:56 A.M.	Prism	2.5	20.5
	11:57 A.M.	Prism	1	19
	12:04 P.M.	Prism	7	25
	12:11 P.M.	Prism	9	27
	12:15 P.M.	Prism	9	27
	12:25 P.M.	Prism	10.5	28.5
	12:27 P.M.	Prism	10.5	28.5
	12:40 P.M.	Prism	12.2	30.2
	1:51 P.M.	Prism	14	32
	2:39 P.M.	Prism	14	32
	2:40 P.M.	Started wearing regular Rx.		
	2:41 P.M.	Reg.	26	26
	2:42 P.M.	Reg.	24	24
	2:44 P.M.	Reg.	24.5	24.5
	2:49 P.M.	Reg.	24.5	24.5
	2:55 P.M.	Reg.	25	25
	2:58 P.M.	Reg.	22.5	22.5

Date	Time	Rx.	Measurement Through Rx. (Centrads)	Squint Angle (Centrads)
	3:00 P.M.	Reg.	19	19
	3:27 P.M.	Reg.	23.5	23.5
	3:28 P.M.	Reg.	23	23
	3:31 P.M.	Reg.	24	24
	3:37 P.M.	Reg.	22.5	22.5
	4:28 P.M.	Reg.	17	17
	4:30 P.M.	Reg.	16.2	16.2
	4:31 P.M.	Reg.	15	15
	4:32 P.M.	Reg.	19.5	19.5
	4:34 P.M.	Reg.	18	18
6-26-46	9:33 A.M.	Reg.	13	13
	9:35 A.M.	Reg.	13	13
	1:40 P.M.	Reg.	12.5	12.5
	1:42 P.M.	Reg.	12.7	12.7
6-27-46	9:30 A.M.	Reg.	13.5	13.5

tion to the prism prescription is smoother and more regular than the re-adaptation to the regular prescription. It should be pointed out that the actual transitions, especially in the case of the decrease of squint angle shown in Figure 3, were not as smooth as suggested by the curves, for the deviations of the data from the curve often represented actual deviations rather than errors of measurement.

INCIDENTAL OBSERVATIONS

In order to ascertain whether the convergence induced by the prisms was accompanied by any changes in accommodation, skiametric measurements of the refractive error were made on June 14 and June 21, the former being at a time when the angle of squint was at its maximum, and the latter when the angle was at its minimum. Six determinations of the "with" limit and six of the "against" limit of the "neutral" zone were made on each of the two days. The measurements were made in the 80-degree meridian of the right eye only, and, as the reflex was somewhat irregular, the same portion of the reflex was used each time. The arithmetic means of the measurements were taken as the neutral points. The results indicated that the changes in convergence induced by the prisms were not accompanied by any changes in accommodation.

The subjective symptoms noted in connection with the experiment were as follows. Within an hour after the prisms were first worn, the subject became aware of a rather severe headache. This headache seemed to be localized around the eyes and in the lower frontal region of the head. The pain seemed to be a more-or-less dull ache rather than sharp, piercing or throbbing. When the subject closed his eyes

and relaxed for a few minutes, momentary relief seemed to appear but as soon as he opened his eyes, the headache returned. This continued throughout the first day. After a restful sleep that night, the headache disappeared. On the morning of the second day, however, after the prisms were worn for approximately an hour, the headache reappeared and remained until about noon at which time it disappeared and did not return. No subjective symptoms of discomfort appeared when the prisms were removed. The greater weight of the glasses containing the prism did not seem to be a factor in the discomfort. The subject was not aware of any projection or field distortions while the prism glasses were being worn, although some preliminary pointing tests through the prism glasses showed that the direction of projection was consistently off, and that readjustment would therefore be necessary. The dispersion effect of the prism was noticeable, however, and the subject was somewhat confused by the peculiar color fringes which appeared around objects viewed in bright illumination.

DISCUSSION

The effect of the prisms on the angle of squint described in this report is in agreement with the results obtained by Hofstetter in two other esotropic subjects. It is difficult to ascertain what type of convergence is involved in this phenomenon. Hofstetter[7] points out that there must exist a type of convergence that cannot be considered one of the classical varieties of convergence described by Maddox[11] and others. At first consideration, it would seem that the convergence demonstrated here likewise cannot be classified among the classical varieties.

On the other hand, there seems to be some similarity between this type of convergence and fusional convergence in the sense that, when the image on the retina of the squinting eye falls nasal to the "false fovea," the eyes converge until the images fall again on the anomalous corresponding points. On the basis of the data obtained in this investigation, it is not easy to rule out the possibility that the neurological mechanism responsible for this is the same as that which provides the fusional convergence in cases with normal binocular vision. The absence of the usual phenomena associated with fusion and fusional movements, such as certain degrees of voluntary control, rapidity of adjustments, stereopsis, etc., may be camouflaging the identity.

The subject was unable to control these changes in convergence at will. Thus it seems likely that the act is involuntary although such

an assumption cannot be considered conclusive without further experimentation.

That the effect is not one of accommodative convergence was adequately demonstrated by the fact that the variations in the angle of squint occurred without any change in the amount of accommodation in play.

It is possible that the mechanism involved in this phenomenon is the same as that which might be postulated to account for the results demonstrated by Marlow, Ellerbrock and Fry, Alpern, and others as discussed by Hofstetter[7].

It is impossible to ascertain from the experiment just exactly what constitutes the stimulus for this type of convergence. One logical possibility is that the disparity of the retinal images causes the eyes to converge in order to make the images fall on anomalously corresponding retinal points. Hofstetter, however, has demonstrated a similar phenomenon in squinters with normal retinal correspondence.

One additional implication of the results of this experiment should be pointed out. This is in connection with the correction of strabismus by surgery on the extraocular muscles. There is little to indicate that, in the prognosis of such surgery, much, if any, consideration is given to the possibility of compensatory convergence adjustments, such as are described above, manifesting themselves subsequent to the operation. Occasional reversions to the original angle of squint following an operation are usually attributed to cicatricial tension or to inaccurate surgical procedure. It is reasonable to suspect that such reversions are identical to the adjustments made by the subject described here. In the light of the data of this experiment, it may well be suspected that in this subject a simple muscle operation would fail to produce the desired result. If it can be shown to be true that the post-surgical changes in angle of squint are identical to the effects produced by prism glasses, the wearing of prism lenses as a prognostic procedure prior to recommending an operation would be a very valuable optometric test.

SUMMARY AND CONCLUSION

A description is given of the effect of fitting a concomitant esotropic subject with a relieving prism for constant wear. The prism was found to increase the angle of squint by an amount equal to the power of the prism.

Certain implications of these results are discussed.

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THE EFFECT OF MIRROR HOLE IN RETINOSCOPY*

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New York, New York

One of the puzzling points in the theory of retinoscopy is the difficulty of explaining the presence of a light reflex at the stage of neutralization. For at that stage the mirror and its hole, whether complete or partial, are sharply focused on the patient's retina. The hole must be imaged as a dark circular area on the fundus and therefore it would seem there should be no light reflex at all. When the mirror and hole are not sharply focused the overlapping diffusion circles from the silvered area would overlap and fill in "the gap," i.e., the image of the hole. But when the mirror and hole are sharply focused this explanation would not do.

The usual explanation for this phenomenon is to blame the more or less constant irregular refraction and multiple aberrations of the eye which, it is true, prevent perfect image formation and thus, in a way, scatter the light. There is, however, another aspect of the matter which is often overlooked and which offers a more reasonable explanation. This involves a separate analysis of the image of the *mirror* and the image of the *light source.*

If a light source, L, say, a 60 watt concentrated bulb with a diaphragm and a round aperture of, say, 20 mm. is placed one meter from a plane mirror, a 20 mm. round image will be formed one meter behind the patient. This image which may be called the effective light source L' produces an image of itself on the retina of the patient, the so-called retinal light patch. This light patch, P for short, is formed by the light reflected regularly from the mirror. When P is sharply focused it shows no effect of the hole in the mirror, except that it is fainter than if there were no hole. This is very much the same as when getting the image of a light source by means of convex lens over the center of which is pasted a bit of opaque paper. When the image is sharply focused the central opaque area does not show up at all. When the image is out of focus, the central opaque area appears as a shadow in the midst of the diffused image of the light source.

In addition to the regularly reflected light which produces P

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there is also a certain amount of irregularly reflected light from the mirror which forms an image of the *mirror* itself on the retina of the patient's eye. When the mirror image is sharply focused, the central hole will be sharply focused too, and will appear as a dark area in the center of a luminous field. When the image of the mirror is out of focus, the diffusion circles from the parts surrounding the aperture will fill in the dark area and the whole will appear about uniformly bright. The image of the mirror which really forms the extremes of the luminous field in retinoscopy may be conveniently referred to as the field or F and the image of the hole as the image space or S.

We see that there is a kind of antagonism between P, S and F. When the light patch is sharply focused the effect of the hole disappears. When P is out of focus the hole produces a central dark shadow. But it is different with F and S. When F and S are sharply focused, the effect of the hole is most marked and S will appear as a dark area in a bright field. But when F and S are out of focus the effect of the hole disappears and a more or less uniform bright field is produced.

The light reflected from the patient's retina is the basic source of the reflex seen by the examiner. We may say that this reflected light has two components, that which is reflected from P and that which is reflected from F. Or rather we may say that the patient's retina receives regularly reflected light to form P and irregularly reflected light to form F and S, and itself reflects the light received from both sources.

But it is evident that we can get a light reflex in the pupil even when S is sharply focused, without considering aberrational effects which unquestionably also play some part in the process. To get both P and S in sharp focus at the same time is not possible since L' would have to be in the plane of the mirror. But this condition can be approximated and is generally not too far off in ordinary practice. If a plane mirror is used and L is alongside the patient and one meter in front of the examiner L' is one meter behind him and two meters from the patient. The light from L' will reach the patient's eye with a divergence of 0.50 D. At the stage of neutralization the patient's eye will be 1.00 D. myopic, F and S will be sharply focused, P will be out of focus only 0.50 D. This slight blurring will not bring out the hole effect to any extent.

We may examine for a moment the phenomena due to the mirror hole while approaching neutralization. When the eye is still 1.00 D. off neutralization say from the "against" side, that is, it would take a —1.00 D. more to get neutral at one meter, F and S are out of focus

1.00 D. P is out of focus 1.50 D. The hole effect due to P being out out of focus would be wholly or partly neutralized by F and S being out of focus. If a —0.50 D. is used, F and S will be 0.50 D. out of focus and P will be out of focus 1.00 D. When —1.00 is used F will be in sharp focus and P will be out of focus 0.50 D. If the patient is 1.00 D. off neutralization from the "with" side, that is, it would take a +1.00 D. more to produce neutralization, F and S will again be out of focus 1.00 D., but P will be out of focus only 0.50 D. If a +0.50 lens is used, F and S will be out of focus 0.50 D. and P will be in full focus. Finally, when +1.00 D. is used, F and S will be in sharp focus and P will be out of focus 0.50 D.

It can be seen from the above that in approaching neutralization from the "with" side the reflex will tend to be brighter because the darkening effect of the hole on P will be less. When 1.00 D. off neutralization from the "with" side P is 0.50 D. out of focus as against 1.50 D. out of focus when the eye is 1.00 D. off neutralization on the "against" side. When the eye is 0.50 D. off neutralization from the "with" side P will be in full focus whereas when the eye is 0.50 D. off neutralization from the "against" side P will be out of focus 1.00 D. This may explain, in part at least, why it is generally easier to get neutralization with plus lenses, that is, from the "with" side than from the "against" side with minus lenses.

The realization that the retinoscopy mirror forms two images in the patient's eye, one of the light source and another one of itself helps to explain some other phenomena in retinoscopy. The tendency now is to use more and more hole-less mirrors so that the shadow effect from the mirror hole is entirely removed. But an understanding of the effect of such hole as discussed above will prove helpful in understanding many other phases of retinoscopy.

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CERTIFICATION BY THE CONTACT LENS SECTION*

At a meeting of the contact lens section of the American Academy of Optometry held in Chicago in December, 1947, there was unanimous agreement as to the need for systematized training and certification of those who are presently engaged in, or who contemplate engaging in, the practice of the application of contact lenses. A committee was appointed to draft a recommendation to the Executive Council of the American Academy of Optometry urging the establishment of minimum standards and an examination for those desiring to become diplomates.

The following is the text of the resolution which was approved

*Report presented by Dr. John C. Neill, Chairman, Contact Lens Section, American Academy of Optometry.

by the contact lens section and which was transmitted to the Executive Council for their consideration:

"It is recommended to the Council that certificates should be awarded to members of the contact lens section of the Academy who have complied with certain minimum requirements and who have successfully passed an examination to be given by an examining board.

"It is further recommended that applicants presently engaged in the application of contact lenses who shall have presented evidence of their experience by the submission of not less than 20 records of successful contact lens cases which he has completed, together with evidence of formal instruction, or its equivalent, in the application of contact lenses, shall be eligible for examination by the examining board beginning at the 1948 meeting. Diplomates of this examination and of subsequent examinations will serve as a control panel for the certification of candidates for the certificate who apply after the 1948 examination.

"Following the creation of the control panel of diplomates at the 1948 examination the examining board shall set up minimum standards for qualification at subsequent examinations. These standards are to consist of a prescribed course of postgraduate study offered by a recognized and accredited optometric institution, or such postgraduate courses as may be approved by the Academy; the submission of not less than 20 records of contact lens cases successfully completed and validated by a member of the control panel assigned to the candidate, and an examination by the examining board in both written and practical aspects of contact lens application."

After careful deliberation the Executive Council of the American Academy of Optometry approved the resolution of the contact lens section and authorized plans to be executed to place the program of certification into immediate operation.

PURPOSES OF CERTIFICATION AND THE EXAMINING BOARD

1. To elevate the standards of contact lens practice.
2. To determine the competence of practitioners professing to be specialists in the application of contact lenses.
3. To arrange and conduct examinations to test the qualifications of candidates who appear before the board for certification as specialists in the application of contact lenses.
4. To grant and issue certificates of qualification as specialists in the application of contact lenses to candidates successful in demonstrating their proficiency.
5. To establish a control panel of diplomates who will act as advisers to candidates for the examinations.
6. To serve the public and the professions by indicating with a designated symbol in the Directory of the American Academy of Optometry that the individual has been certified as a contact lens specialist.

NO LEGAL OR PROFESSIONAL RESTRICTIONS

The certificate does not of itself confer on the diplomate any legal qualifications, privileges, or license to practice the application of

contact lenses. It is not the purpose or intent in any way to interfere with or to limit the professional activities of any duly licensed optometrist. The chief aim is to elevate the standards of qualification for specialists in the application of contact lenses and to certify as specialists those Fellows of the American Academy of Optometry who appear before the examining board and are successful in meeting the requirements.

VALUE OF CERTIFICATION

The American Academy of Optometry recognizes the certificate as evidence of academic and clinical fitness in the practice of contact lens application. Diplomates will be recognized by a suitable symbol opposite their name in the Directory. This Directory listing will serve as a guide to other optometrists desiring to refer patients for consultation and services in this specialty.

REQUIREMENTS

All candidates who are presently engaged in contact lens practice and who file application for examination before December, 1948, will be required to submit the records of 20 successful contact lens cases which he has completed, together with evidence of formal instruction or its equivalent in the application of contact lenses. Upon acceptance of these prerequisites by the examining board the candidate will be notified to appear before the board for oral, written and practical examinations which will be given immediately preceding the December, 1948, meeting of the American Academy of Optometry.

Those candidates who file application before December, 1948, and who have not completed the prerequisite number of cases will be notified to appear for examination but the awarding of the certificate will be withheld pending completion of the required number of cases.

Candidates who file application after December, 1948, must:

(a) Submit a statement from an accredited optometric institution showing satisfactory completion of a post-graduate course of instruction in the application of contact lenses.

(b) Submit the records of 20 successful contact lens cases which have been completed under the supervision of a member of the control panel who has been assigned to the candidate.

(c) Appear before the examining board for a practical, oral and written examination.

THE CONTROL PANEL

Diplomates of the 1948, and subsequent examinations will serve

as a control panel for the certification of candidates who apply after the 1948 examination. A member of the control panel will be assigned to each candidate and it will be the duty of the panel member to assist the candidate with each of his cases. Within geographic limitations an effort will be made to bring together the panel member and the candidate with his patient, for the purpose of consultation. Where for geographic reasons, it is impracticable for the candidate to consult personally with the panel member, the candidate will keep the panel member informed by correspondence with his progress in the application of contact lenses to each of his patients.

When the candidate has successfully completed the prerequisite number of cases under the supervision of the panel member assigned to him, the panel member will validate each case to the examining board.

PREPARATION FOR CERTIFICATION

All candidates will be examined in the subjects basic to the application of contact lenses. These subjects will include the anatomy, histology and physiology of the anterior segment of the eye and its adnexia, the chemistry of contact lens solutions, the optics of contact lenses and the pathology and therapeutics associated with contact lens practice. The candidate will also be examined in the historical development of contact lenses as well as the modern forms of such lenses, including both moulded and trial case types. The practical examination will be limited to the particular method or methods employed by the candidate in applying contact lenses to the cases reported by him to the examining board; however, he will be expected to be able to discuss intelligently other methods of contact lens application.

In preparing for the examination the candidate will be guided by the syllabus prepared by the examining board. A sample of the form to be used in submitting case records will be furnished the applicant.

FEES

An application form will be furnished to each applicant and this form must be filled out completely and accurately and returned to the secretary together with an application fee of $10.00. The examination must be taken within three years of date of application. When the candidate is notified to appear for examination an examination fee of $25.00 must be remitted to the secretary.

Following the 1948 examination, examination fees will be carefully computed on a basis of the cost of administering the examination.

All fees will be used entirely for administrative expenses. Examiners will serve without compensation other than actual expenses.

RE-EXAMINATION

Candidates who have failed one or more subjects may be re-examined upon satisfactory evidence of adequate additional preparation and payment of the examination fee. A minimum of one year must elapse between examinations.

REVOCATION OF CERTIFICATE

The Certificate of Qualification may be revoked in the event that:

(a) Any representation or statement made to the board by the Fellow, including statements contained in his application for certification, shall have been false or intentionally misleading,

(b) The Fellow so certified shall violate the standards of practice of optometry required by the American Academy of Optometry; or the revocation, forfeiture or suspension of his license to practice optometry.

Upon revocation of any Certificate of Qualification by the Academy as aforesaid, the holder thereof shall return his Certificate of Qualification and all other evidence of certification to the secretary and his name shall be removed from the list of diplomates.

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TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

CHAPTER ACTIVITIES

ARKANSAS CHAPTER ELECTS OFFICERS

Dr. O. H. Johnson, Jonesboro, was elected president of the newly-organized Arkansas chapter at their initial meeting held in January. Dr. Hugh A. Pennington, Paragould, was elected vice-president, and Dr. Charles H. Brown, Little Rock, secretary-treasurer. Dr. C. G. Melton was chosen to serve on the Arkansas chapter executive council.

"ILLUMINATION" DISCUSSED AT
EASTERN PENNSYLVANIA CHAPTER

Dr. William M. Gilbert, Academy member and authority on il-

lumination, was the principal speaker at the January meeting of the Eastern Pennsylvania chapter.

CUYAHOGA CHAPTER SPONSORS READING CONFERENCE

A conference on reading problems, sponsored by the Cuyahoga (Ohio) Academy of Optometry, was held February 14, 1948 at the Cleveland Board of Education auditorium.

The program was arranged especially for those interested in reading instruction and its problems. Educators of Northern Ohio were guests of the chapter.

The Cuyahoga Academy hopes to make this conference, the first of its kind, an annual affair. Following is the program presented at the one-day session:

Dr. Howard F. Haines, School of Optometry, Ohio State University, "Maturation and Visual Readiness to Read."

Dr. Wilmot F. Schneider, child psychiatrist, "Readiness and Emotional Problems Associated with Reading Disabilities."

Dr. Matthew Luckiesh and S. K. Guth, Lighting Research Laboratories, General Electric Company, "Reading as a Visual Task."

Miss Margaret L. White, Directing Supervisor of Language Arts, Cleveland Board of Education, "Locating the Poor Reader."

Dr. Helen M. Robinson, Director of Reading Clinics, University of Chicago, "Discovering the Causes of Reading Deficiency."

Dr. Paul A. Witty, Professor of Education, Northwestern University, "Remedial Reading and the Prevention of Reading Difficulties."

EDUCATIONAL SKILLS SPECIALIST SPEAKS TO MINNESOTA CHAPTER

Emotional disorders which might be affecting visual skills should be watched for by optometrists working with young people. Often a student does not come into the office with just an isolated visual problem. He comes in with feelings and problems that govern his behavior, and professional men must recognize this fact.

This was the advice of Mrs. William T. Nicholas, senior counsellor, Educational Skills Clinic, University of Minnesota, to Minnesota Academy members attending the winter meeting of the chapter.

Mrs. Nicholas is a teacher of 17 years experience, and did her graduate work under Dr. Emmett Betts, specialist in reading training now at Temple University, Philadelphia.

Mrs. Nicholas cited an example of a college student who was failing in his school work and thought his trouble was due to poor vision. He did have a visual problem, and it was thought his work would improve after he was properly fitted with glasses.

"It didn't, and on the surface this case looked like a failure from the refractionist's standpoint," Mrs. Nicholas said.

"Psychoanalysis revealed, however, that this student was married

to an 'A' student, and that his excuses of extreme fatigue, lack of interest, and poor vision were only symptoms of the basic problem—his desire to keep up with his wife which he wasn't capable of doing, at least not in the field he had chosen to enter." Mrs. Nicholas said when school counsellors found that he lacked the ability in the field he was working, it was suggested to this young man that he change into a field where he could excel.

"In other words, we redirected his whole goal," she explained. "Actually, his glasses were properly fitted, and his visual skills normal when wearing his correction."

Mrs. Nicholas went on to say that obviously an optometrist cannot spend the time required for psychoanalysis, but suggested that professional men fortify themselves with a working knowledge of abnormal and educational psychology.

"By doing this, the optometrist could learn to recognize symptoms of emotional disorders," she declared.

The ideal setup, according to Mrs. Nicholas, would be to refer the student (patient) to a psychiatrist after noting symptoms indicating the need for one.

One way to attack the problem, Mrs. Nicholas pointed out, is for parents, teachers, and optometrists to cooperate closely with each other in working out a child's problems.

"Teachers and optometrists especially should keep each other informed about the child in question," she emphasized.

The teacher can explain behavior problems and apparent visual difficulties to the optometrist. The optometrist should inform the teacher (1) whether the child is visually efficient at all working distances, and (2) the extent of his ability to sustain efficient vision at the various distances required in the schoolroom, according to Mrs. Nicholas.

"Teachers need to learn that while a child may be able to see the blackboard clearly, he may not be seeing singly and clearly," Mrs. Nicholas added.

The educator pointed out that the chief responsibility of the optometrist, as she sees it, is to prepare the child for sustained vision and keep the teacher informed of the child's progress.

She also urged Academy members to remember their responsibility to school children not only as professional men, but as members of the community as well.

"There are so many pressures brought to bear today on teachers, parents, and professional people that we sometimes lose sight of our

responsibility for the well-being of the children in our schools," she explained.

According to Mrs. Nicholas, an optometrist should, as a member of the community—and as a vision specialist—do the following:

See to it that poor lighting due to sunglare, poor seating arrangements, inadequate window shades, and poor artificial light, is corrected in schoolrooms.

Help the teacher familiarize herself with visual problems confronting the child in the schoolroom.

Urge teachers to reduce the near point load if possible, and to vary the visual pace required of the child to help avoid visual fatigue.

"Many teachers do not realize that maps, charts, books, blackboards and movies each require a different visual skill and that some children are not able to perform all these visual tasks adequately," Mrs. Nicholas said. "Especially, they do not realize that while the child may be able to sustain vision properly for a short time, he will become extremely fatigued if required to do the same visual task for long periods of time," she added.

Venetian blinds were recommended by the speaker as one solution to sunglare in schoolrooms.

Mrs. Nicholas spoke to Academy members at the request of Dr. H. C. Sherratt, Minneapolis, visual skills specialist, who works with her on the visual problems of Minneapolis school children.

Minnesota chapter members voted at this meeting to hold a seminar on industrial vision and near point skills on May 9, 1948.

VIRGINIA HUCK

ANNOUNCEMENTS

INTERNATIONAL CONFERENCE AT WINNIPEG

Three United States optometrists and two Canadian health officers will be the speakers at the annual convention of the Manitoba Optometric Society this year. The conference is scheduled for February 23-24 at Winnipeg, Manitoba.

The speakers will be: Dr. S. S. Grupposo, Southbridge, Massachusetts; Dr. C. A. Halbkat, Watertown, South Dakota; Dr. F. Branchaud, Cavalier, North Dakota; Mr. Trevor Davies, Manitoba Safety Director, Winnipeg, and Dr. M. Lougheed, Health Officer, Winnipeg.

In keeping with a custom started two years ago, a delegation from the North Dakota Optometric Association will attend.

Officials plan to develop the convention into a regional conference. Last year, delegates from North Dakota, Minnesota, Ontario and Saskatchewan were present, according to E. I. Cummings, Manitoba Optometric Society secretary.

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These two frames have won professional and public approval, first for their ophthalmic perfection and, secondly, for their design which together unite scientific accuracy with the height of facial attractiveness. They thus emphasize the supreme importance of constant vision care and prove that it can be successfully combined with cultured physical appearance.

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Thanks to the Profession. And for frames that don't impede our vision and help us to look our very best!

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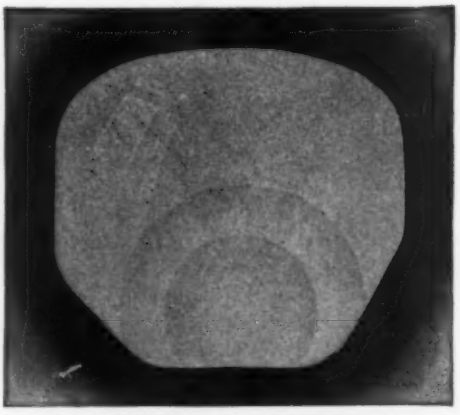

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FROM the beginning, those marvelous, all-seeing eyes were at work. By flickering hearthfire, by the dim gleam of candle and lantern, those patient, tired eyes were unfaltering in the search for knowledge and truth, as they probed to "see the right". Through them, *Abraham Lincoln*—the boy, the gangling storekeeper, the traveling lawyer, the great-hearted president—found the Light that was to illumine the pathway to freedom and tolerance for all of mankind. We owe much to Lincoln's immortal eyes.

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History records that Abraham Lincoln, at the age of 47, bought his first pair of spectacles "over the counter" in a casual store visit! Today, there is no need for such abuse of priceless eyesight on which we depend for 83% of our knowledge. Modern ophthalmic science, through the professional services and skills of the ophthalmologist, the optometrist and the ophthalmic dispenser (optician) can do wonders to preserve and extend the precious quality of good vision. *Have you had your eyes examined lately?* BETTER VISION INSTITUTE, INC., 630 FIFTH AVENUE, NEW YORK 20, N. Y.

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HARDx LENSES (Toughened to Resist Breakage)
SOFT-LITE LENSES (Neutral Light Absorption the 4th Prescription Component)

N. P. BENSON OPTICAL COMPANY

Established 1913

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